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I claim:

1. A method of treating an underground formation that has been penetrated by a well, the well having a wellbore, the method comprising the steps of:

lowering a valve into the well until the valve is adjacent the formation with the valve being placed to control flow of fluid between the formation and the wellbore;

establishing a pressure differential across the valve; and

selectively and repeatedly opening and closing the valve to cause cyclical pressure variation in the formation and induce surges of fluid from the formation into the wellbore.

2. The method of claim 1 further comprising the steps of:

providing a source of pressurized treatment fluid in fluid communication with the valve; and

injecting treatment fluid from the source of pressurized treatment fluid into the formation to increase the pressure in the formation above the formation pressure prior to each surge of fluid ~~from~~ into the formation. RA July 21/2000

3. The method of claim 1 in which the cyclical pressure variation rises above formation pressure during injection of treatment fluid and drops below formation pressure during surge of fluid from the formation.

4. The method of claim 3 in which treatment fluid is injected into the formation through a first flow channel extending from the surface and fluid from the formation is returned towards the surface through a second flow channel distinct from the first flow channel.

5. The method of claim 4 in which the valve has multiple ports, including at least a first port for controlling flow in the first flow channel and a second port for controlling flow in the second flow channel.

6. The method of claim 4 in which the first flow channel is formed by the interior of a first string of tubing and the second flow channel is formed by an annulus between the first string of tubing and a second string of tubing.

7. The method of claim 1 further comprising the step of isolating the formation prior to inducing pressure surges in the formation.

8. The method of claim 7 in which the formation is isolated by inflating a packer above the formation to be treated.

9. The method of claim 8 in which inflating the packer comprises injecting fluid from the first flow channel into the packer under control of the valve.

10. The method of claim 8 further comprising the step of inflating a packer below the formation to be treated.

11. The method of claim 1 further comprising the step of monitoring pressure variation in the formation during treatment of the formation.

12. The method of claim 11 further comprising the step of terminating release of pressure from the formation when the formation pressure reaches a pre-set pressure.

13. The method of claim 12 in which the pre-set pressure is the formation pressure.

14. The method of claim 1 further comprising the step of monitoring pressure variation in the wellbore during treatment of the formation.

15. The method of claim 1 further comprising the step of monitoring pressure variation in the first flow channel during treatment of the formation.

16. The method of claim 1in which the treatment fluid injected into the formation is nitrogen.

17. The method of claim 1 in which, between surges, the formation pressure is allowed to build up naturally, without injection of fluid from the surface.

18. A method of controlling fluid flow in a well, the method comprising the steps of:

lowering into the well a multiport valve operable by an electric motor; and

controlling fluid flow in the well by opening and closing ports in the multiport valve under instruction from the surface to the electric motor.

19. The method of claim 18 in which the multiport valve is suspended on the end of a tubing string and further comprising the step of injecting fluid through a first flow channel to the multiport valve to force fluid in the wellbore towards the surface.

20. The method of claim 19 in which the multiport valve is provided with at least one packer suspended on the tubing string below the multiport valve and control of fluid is carried out while the packer is not inflated.

21. A method for treating wells, the method comprising the steps of:

providing a tubular arrangement for installation in a well bore which produces two distinct channels for segregated fluid flow; the first channel providing a flow path from

pumping equipment at surface to a down hole tool assembly; and the second channel for fluid flow from the down hole tool assembly to flow control equipment at surface;

lowering a bottom hole assembly which has been attached to the distal end of the tubular arrangement into the well bore to the desired depth;

isolating at least one linear segment of the well bore from the remainder of the well bore by the use of one or more well bore sealing elements or packers which form part of the down hole tool assembly;

filling the first flow channel with fluid and opening a valve in the down hole assembly to allow the fluid in the first channel to flow into the formation adjacent to the section of the well bore which has been isolated from the remainder of the well bore;

closing said valve in the down hole assembly; and

opening a valve in the down hole assembly to allow the fluids injected into the formation, as well as fluids and solid materials from the formation to flow back into the second flow channel.

22. A method for removing solid materials including formation cuttings, formation fines, sand, drilling fluid suspended solids, drilling fluid filter cake, sediments, and precipitates from a well bore and from the pore spaces in the formation surrounding said well bore, such method comprising;

providing a tubular arrangement for installation in a well bore which produces two distinct channels for segregated fluid flow; the first channel for fluid flow from flow control equipment at surface to a down hole tool assembly; and the second channel for fluid flow from the down hole tool assembly to flow control equipment at surface;

lowering a bottom hole assembly which has been attached to the distal end of the tubular arrangement into the well bore to the desired depth;

isolating at least one linear segment of the well bore from the remainder of the well bore by the use of one or more well bore sealing elements or packers which form part of the down hole tool assembly;

filling the first flow channel with fluid and opening a valve in the down hole assembly to allow the fluid in the first channel to flow into the formation adjacent to the section of the well bore which has been isolated from the remainder of the well bore;

closing said valve in the down hole assembly; and

opening a valve in the down hole assembly to allow the fluids injected into the formation, as well as fluids and solid materials from the formation to flow back into the second flow channel.

23. A method for removing liquids, emulsions, colloidal suspensions and other multi-phase fluids from the region surrounding a well bore, such method comprising;

providing a tubular arrangement for installation in a well bore which produces two distinct channels for segregated fluid flow; the first channel for fluid flow from flow control equipment at surface to a down hole tool assembly; and the second channel for fluid flow from the down hole tool assembly to flow control equipment at surface;

lowering a bottom hole assembly which has been attached to the distal end of the tubular arrangement into the well bore to the desired depth;

isolating at least one linear segment of the well bore from the remainder of the well bore by the use of one or more well bore sealing elements or packers which form part of the down hole too assembly;

filling the first flow channel with fluid and opening a valve in the down hole assembly to allow the fluid in the first channel to flow into the formation adjacent to the section of the well bore which has been isolated from the remainder of the well bore;

closing said valve in the down hole assembly; and

opening a valve in the down hole assembly to allow the fluids injected into the formation, as well as fluids and solid materials from the formation to flow back into the second flow channel.

24. The method of claim 21 where two sealing elements or packers are used to isolate a segment of the well bore from the remainder of the well bore on either side of said segment.

25. The method of claim 21 where more than one segment is isolated from each other and the remaining well bore through the use of three or more sealing elements or packers.

26. The method of claim 21 where the process of opening a down hole valve, injecting fluid into the formation and then closing said valve, followed by the process of opening a valve and allowing the injected fluids to surge back into the second flow channel is repeated one or more times.

27. The method of claim 21 where the first fluid channel is formed within a continuous string of coiled tubing, and the second fluid channel is formed in the annular area between the coiled tubing and the well casing which may extend to the bottom hole assembly. Where the casing only extends a portion of the way to the bottom hole assembly, the open hole well bore

will form the continuation of the casing for purposes of forming the outer wall of the fluid channel. The down hole assembly is attached to the end of the coiled tubing.

28. The method of claim 21 where the first channel is formed within a string of jointed tubing or drill pipe and the second fluid channel is formed in the annular area between the jointed tubing or drill pipe and the well casing which may extend to the bottom hole assembly. Where the casing only extends a portion of the way to the bottom hole assembly, the open hole well bore will form the continuation of the casing for purposes of forming the outer wall of the fluid channel. The down hole assembly is attached to the end of the jointed tubing or drill pipe.

29. The method of claim 21 where a string of coiled tubing is located axially inside a second string of coiled tubing and this concentric coil-in-coil tubing string is used to deliver the down hole assembly, and the fluid channels in each of the coils is segregated from the other such that one coil forms the first fluid channel and the other coil forms the second channel.

30. The method of claim 29 where the first fluid channel is formed by either of the inner or outer coiled tubing string, and the second fluid channel is formed by the annular area between the outer coiled tubing string and the casing and/or well bore diameter.

31. The method of claim 21 where the down hole assembly is delivered by jointed tubulars and a single string of coiled tubing is then inserted axially inside the jointed tubulars and sealed from the jointed tubing such that the fluid channels in each of the jointed and coiled tubing strings is segregated from the other and one fluid channel forms the first fluid channel and the other forms the second fluid channel.

32. The method of claim 31 where the first fluid channel is formed by either of the inner coiled tubing string or the outer jointed tubing string, and the second fluid channel is

formed by the annular area between the outer coiled tubing string and the casing and/or well bore diameter.

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33. The method of claim 21 where two strings of ~~concentric~~ coiled tubing are located axially beside each other and this dual coiled tubing string is used to deliver the down hole assembly, and the fluid channels in each of the coils is segregated from the other such that one coil forms the first fluid channel and the other coil forms the second channel.

34. The method of claim 33 where the first fluid channel is formed by either coiled tubing string, and the second fluid channel is formed by the annular area between the coiled tubing strings and the casing and/or well bore diameter.

35. The method of claims 21, and 32, 33 where the sealing elements or packers are inflatable in nature and are expandable by the use of a valve in the down hole assembly to allow pressure from the first fluid channel to flow into the sealing elements.

36. The method of claim 35 where a valve in the down hole assembly allows the pressure and fluid from the packers to be vented to the second fluid channel to deflate the packers back to their original shape.

37. The method of claim 21 where the pressure at the down hole assembly in the first fluid channel, prior to opening said valve to allow fluid to flow into the isolated well bore segment, is higher than the pressure in the formation.

38. The method of claim 21 where the second fluid channel is initially void of fluids.

39. The method of claim 21 where the pressure at the down hole assembly in the second fluid channel is less than the formation pressure.

40. The method of claim 21 where the fluid injected into the reservoir is in a liquid state.

41. The method of claim 21 where the fluid injected into the reservoir is in a gaseous state.

42. The method of claim 21 where the fluid injected into the reservoir is a two phase mixture of fluids in a gaseous and liquid state.

43. The method of claim 21 where the injected fluid is alternated between a liquid phase for one injection cycle and a gas for the subsequent injection cycle.

Claims Relating to the Tool

44. An apparatus for use in well treating and evaluation operations which comprises:

a tubular arrangement for installation in a well bore which produces two distinct channels for segregated fluid flow; the first channel providing a flow path from pumping equipment at surface to a down hole tool assembly; and the second channel for fluid flow from the down hole tool assembly to flow control equipment at surface;

a bottom hole assembly which has been attached to the distal end of the tubular arrangement;

at least one well bore sealing element or packer which forms part of the down hole tool assembly and is used to isolate a linear segment of the well bore from the remainder of the well bore; and

a fluid control valve system in the down hole assembly which allows the fluid movement through the tool and the surrounding well bore regions to be controlled from surface.

45. The apparatus of claim 44 where the fluid control valve comprises:

a valve housing with a longitudinal bore in the housing;

multiple fluid passages drilled longitudinally in the valve housing parallel to the valve bore, said passages providing fluid flow from the tubing string above the valve, the well bore area above the packers adjacent to the valve, the well bore area below the upper packer, and the interior area of the packer(s);

passages drilled at positions along the valve bore and perpendicular to the valve bore which connect the valve bore with the fluid passages with openings into the valve bore and the passages;

a valve spool which is inserted into the valve bore and which has cylindrical seals around it to seal the area between itself and the valve bore, as well as an area of reduced diameter and of sufficient length to allow fluid to flow between any two of the openings; and

a valve operator which imparts linear motion to the valve spool in order to position the valve spool (DA July 21/2000 in any one of a given number of positions along the valve bore.

46. The apparatus of claim 45 where the valve operator comprises an electrically operable means of imparting linear motion to the valve spool.

47. The apparatus of claim 46 where the electrically operable means comprises:

an electrical motor with rotary output;

a speed reduction module to reduce the speed of the output shaft of the motor; and

a motion conversion module which converts the rotary motion from the speed reduction module to linear motion.

48. The apparatus of claim 47 which includes a mechanism for sensing or determining the location of the linear shaft and the valve spool.

49. The apparatus of claim 47 where the motor is controlled by a microprocessor or microcontrolled which uses the sensing mechanism of claim ~~28~~ 48 (Dd July 21/2000 and control signals from the tool operator to stop and start the motor.

50. The apparatus of claim 47 where the microprocessor or micro controller is connected to a computer at the surface of the well and each of the computer at surface and the microprocessor or micro controller have software code sufficient to allow them to communicate to each other and to allow commands to be implemented into the surface computer for moving the valve spool to a desired location in the valve bore.

51. The apparatus of claim 47 where pressure sensors in the down hole apparatus are connected to the microprocessor or micro controller and where the micro controller or microprocessor has software code which enables it to determine the pressure measured by the pressure sensors and to implement movements of the valve spool, independent from the tool operator at surface, based upon given pressure parameters.

52. A method of operating a multiple position down hole valve which operates independent of any mechanical movement of the tubing string and independent of any pressure in the tubing string or well bore, such method comprising:

using computer software to initiate a command in a computer or microprocessor or micro controller which is located at the surface of the well location;

having the surface computer send that command to a second microprocessor or micro controller located in the down hole assembly near the fluid control valve;

using the down hole microprocessor or micro controller to sense or determine the position of the valve;

using an electrically operated motor to provide the mechanical force necessary to move the valve from one position to another position;

using the down hole microprocessor or micro controller to switch electrical power in the appropriate polarity to the electrically operated valve control motor;

using the down hole microprocessor or micro controller to sense when the valve has reached the required position; and

using the down hole microprocessor or micro controller to switch off the electrical power to the electrically operated valve motor.

53. The method of claim 52 where a third computer located remotely from the well location is connected by a wireless communications network to the computer at the well location and the command to operate the fluid control valve is given from the remotely operated computer.

54. A method of operating a multiple position down hole valve which operates independent of any mechanical movement of the tubing string and independent of any pressure in the tubing string or well bore, such method comprising:

using computer software to initiate a command in a computer or microprocessor or micro controller which is located at the surface of the well location;

having the surface computer send that command to a second microprocessor or micro controller located in the down hole assembly near the fluid control valve;

using the down hole microprocessor or micro controller to sense or determine the position of the valve;

using an electrically operated motor to provide the mechanical force necessary to move the valve from one position to another position;

using electrically operated pressure sensing devices which are connected to the down hole microprocessor or micro controller, said pressure sensing devices measuring the pressure in one or more of the locations within the tool and well bore which might at any time during the well evaluation or treating operations be different from the pressure at any other location within the tool or well bore, such as the pressure in the tubing string, the pressure in any secondary tubing string, the pressure in any inflatable packers, the pressure in the well bore above the top packer and the pressure in the well bore below the top packer;

using the down hole microprocessor or micro controller to use the pressure sensing data to automatically switch electrical power in the appropriate polarity to electrically operated valve control motor and to move the valve to a specified position based upon preset criteria for the pressure data;

using the down hole microprocessor or micro controller to sense when the valve has reached the required position; and

using the down hole microprocessor or micro controller to switch off the electrical power to the electrically operated valve motor.

Claims Relating to Formation Evaluation

55. A method for evaluating wells which comprises:

providing a tubular arrangement for installation in a well bore which is of a continuous nature and is spoilable on to a reel;

lowering a bottom hole assembly that has been attached to the distal end of the coiled tubing into the well bore to the desired depth, said assembly containing inflatable well bore sealing means, electrically operable multi-position fluid control valve, electrically operable micro-controller, electrically operable pressure sensing devices, and electrically operable communication modem;

pressurizing the coiled tubing to a pressure at the down hole assembly which is greater than the pressure in the well bore at the down hole assembly, said pressures being monitored by the sensing devices in the down hole assembly;

opening the fluid control valve in the down hole assembly to allow the fluid in the coiled tubing to flow into the inflatable packers thereby isolating at least one linear segment of the well bore from the remainder of the well bore;

closing said valve in the down hole assembly;

reducing the pressure in the coiled tubing to a pressure at the down hole assembly which is less than the pressure in the well bore at the down hole assembly, said pressures being monitored by the sensing devices in the down hole assembly;

opening the fluid control valve in the down hole assembly to allow the fluids in the section of the well bore which has been isolated, as well as fluids and solid materials from the formation adjacent to it, to flow into through the valve and into the coiled tubing;

closing said valve in the down hole assembly and recording the pressure response in the well bore isolated from the remainder of the well bore using the pressure sensing devices in the down hole assembly; and

opening the fluid control valve in the down hole assembly to allow the fluids in the inflatable packers to flow into the well bore until the pressure has been equalized and the packers have deflated.

56. The method of claim 55 where more than one period of inflow into the tubing string or more than one period of monitoring pressure build up in the well bore is completed.

57. The method of claim 55 where the fluid used to pressurize the coiled tubing string is a gas.

58. The method of claim 55 where the fluid used to pressurize the coiled tubing string is a mixture of liquid and gas such that the amount of liquid does not create a hydrostatic pressure in the tubing greater than the pressure in the formation adjacent to the down hole assembly.